

In Regard to Boda-Heggemann et al

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Towards the ultimate radiotherapy goal- “freezing” the tumour in a known position during radiotherapy

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Towards the ultimate radiotherapy goal- “freezing” the tumour in a known position during radiotherapy

It was always hoped that if patients held their breath, tumours would stay still. The introduction of multiple short (roughly 20 second) breath-holds in air, to reduce the movement of target organs, is improving radiotherapy delivery for breast cancer [1] and ought to improve the delivery for other thoracic and abdominal tumours. It is important however to be aware that tumours do not stay completely still during breath-holding [2-4]. First, there is settlement of the chest, diaphragm and abdominal organs when the breath-hold is first established [3,5,6]. Secondly, there is shrinkage of the chest volume throughout breath-holding because oxygen continues to be extracted from alveolar gas and is not replaced by an equal volume of carbon dioxide [7]. These physiological changes are in addition to the issues of reproducibility of organ position between each breath-hold.

Colleagues should also be aware that patients with cancer can already breath-hold for more than 10 times longer than in these multiple short breath-holds using air [1]. Parkes *et al.*, have just achieved single prolonged breath-holds [3] for more than 5 minutes using a non-invasive mechanical ventilation technique with 60% oxygen. Here, the initial settlement movement over the first 10-15 seconds of the breath-hold was typically 3 mm and in 15 patients the chest deflated by about 2 mm/minute in the inferior-superior direction (the direction of largest motion in this study). Peguret *et al.*, have achieved single “apnea-like breath-holds” for more than 11 minutes using a high frequency percussive ventilation technique with 100% oxygen [2]. Movements during “breath-holding” were measured with CT and evaluated in detail in 2 patients revealing movement from the start to the end of the breathing that was typically 2-4mm and occasionally larger.

While such prolonged breath-holding techniques have further clinical potential to optimise both imaging and delivery of x-ray and particle beam therapy in a single breath-hold, they also emphasise the urgent need for more research on the position changes of both tumours and healthy tissue throughout breath-holding.

Reference List

1. Boda-Heggemann J, Knopf AC, Simeonova-Chergou A, Wertz H, Stieler F, Jahnke A, Jahnke L, Fleckenstein J, Vogel L, Arns A, Blessing M, Wenz F and Lohr F. Deep Inspiration Breath Hold-Based Radiation Therapy: A Clinical Review. *Int J Rad Oncol Biol Phys* 2016; 94: 478-492.
2. Peguret N, Ozsahin M, Zeverino M, Belmondo B, Durham AD, Lovis A, Simons J, Long O, Duclos Fd, Prior J, Denys A, Beigelman C, Sozzi WJ, Grant K, Gautier-Dechaud V+, Peters S, Vienne M, Moeckli R and Bourhis J. Apnea-like suppression of respiratory motion: First evaluation in radiotherapy. *Rad Oncol* 2016; 118: 220-226.
3. Parkes MJ, Green S, Stevens AM, Parveen S, Stephens B and Clutton-Brock TH. Safely achieving single breath-holds of >5 minutes in cancer patients: feasibility and applications for radiotherapy. *Br J Radiol* 2016; 89: 20160194.

4. Lens E, Van der Horst A, Versteijne E, Van Tienhoven G and Bel A. Considerable intra-breath-hold motion and inter-breathhold position variation of pancreatic tumors. *Radiother Oncol* 2015; 115 (supplement 1): S1444.
5. Lens E, Gurney-Champion OJ, Van der Horst A, Tekelenburg DR, van Kesteren Z, Parkes MJ, Van Tienhoven G, Nederveen AJ and Bel A. Abdominal organ motion during breath-hold measured in volunteers on MRI: inhale and exhale compared. *Estro Conference* (Turin, Italy) 2016
6. Lens E, Gurney-Champion OJ, Van der Horst A, Tekelenburg DR, van Kesteren Z, Parkes MJ, Van Tienhoven G, Nederveen AJ and Bel A. Towards an optimal breath-holding procedure for radiotherapy: differences in organ motion during inhalation and exhalation breath-holds . *AAPM-conference*, Washington DC, USA 2016
7. Parkes MJ. Breath-holding and its breakpoint. *Exp Physiol* 2006; 91: 1-15.